18.3 Solubility Equilibrium >

Ksp

The Solubility Product Constant

What is the relationship between the solubility product constant and the solubility of a compound?

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Constant

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The **solubility product constant** (K_{sp}), equals the product of the concentrations of the ions, each raised to a power equal to the coefficient of the ion in the dissociation equation.

The *smaller* the numerical value of the solubility product constant, the *lower* the solubility of the compound.

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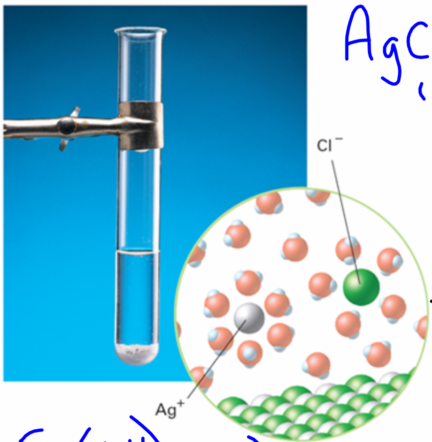
Silver chloride is slightly soluble in water.

Dissociation Eqn

$AgCl_{(aq)} \rightarrow 1Ag^+(aq) + 1Cl^-(aq)$



Ksp = 1.8 x 10⁻¹⁰

$K_{sp} = [Ag^+(aq)]^1[Cl^-(aq)]^1$

$\frac{mol^2}{L^2}$

$Fe(OH)_6(aq) \rightarrow 1Fe^{6+}(aq) + 6OH^-(aq)$

$K_{sp} = [Fe^{6+}(aq)]^1[OH^-(aq)]^6$

$\frac{mol^7}{L^7}$

Table 18.2

Solubility Product Constants (K_{sp}) at 25°C

Salt	K_{sp}	Salt	K_{sp}	Salt	K_{sp}
Halides		**Sulfates**		**Hydroxides**	
AgCl	1.8×10^{-10}	$PbSO_4$	6.3×10^{-7}	$Al(OH)_3$	3.0×10^{-34}
AgBr	5.0×10^{-13}	$BaSO_4$	1.1×10^{-10}	$Zn(OH)_2$	3.0×10^{-16}
AgI	8.3×10^{-17}	$CaSO_4$	2.4×10^{-5}	$Ca(OH)_2$	6.5×10^{-6}
$PbCl_2$	1.7×10^{-5}	**Sulfides**		$Mg(OH)_2$	7.1×10^{-12}
$PbBr_2$	2.1×10^{-6}	NiS	4.0×10^{-20}	$Fe(OH)_2$	7.9×10^{-16}
PbI_2	7.9×10^{-9}	CuS	8.0×10^{-37}	**Carbonates**	
PbF_2	3.6×10^{-8}	Ag_2S	8.0×10^{-51}	$CaCO_3$	4.5×10^{-9}
CaF_2	3.9×10^{-11}	ZnS	3.0×10^{-23}	$SrCO_3$	9.3×10^{-10}
Chromates		FeS	8.0×10^{-19}	$ZnCO_3$	1.0×10^{-10}
$PbCrO_4$	1.8×10^{-14}	CdS	1.0×10^{-27}	Ag_2CO_3	8.1×10^{-12}
Ag_2CrO_4	1.2×10^{-12}	PbS	3.0×10^{-28}	$BaCO_3$	5.0×10^{-9}

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Scale, formed by the precipitation of slightly soluble salts, builds up around faucets.

http://en.wikipedia.org/wiki/Limescale

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Example 1
If $SrCO_3$ has a Ksp of 9.3 x 10 $^{-10}$ find the concentration of Sr $^{2+}$ (aq) ion in solution.

① Write dissociation eqn

$SrCO_3(aq) \rightarrow 1 Sr^{2+}(aq) + 1 CO_3^{2-}$

② Write Ksp expression

$\frac{mol^2}{L^2}$ $Ksp = [Sr^{2+}(aq)]^1 [CO_3^{2-}]^1$

③ Let x be the unknown concentration

$9.3 \times 10^{-10} \frac{mol^2}{L^2} = x^1 \cdot x^1$

$9.3 \times 10^{-10} \frac{mol^2}{L^2} = x^2$

④ Solved for Concentration

$3.04 \times 10^{-5} \frac{mol}{L} = \sqrt{\quad} = x$